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The Development of Scar Tissue in the Brown Shrimp, *Penaeus aztecus*, after Wounding with the Petersen Disk Tag[1]

The wound repair processes of penaeid shrimp after wounding with the Petersen disk tag have been described grossly (C. T. Fontaine, *J. Invertebr. Pathol.* **18**, 301–303, 1971) and histologically (C. T. Fontaine and D. V. Lightner, *J. Invertebr. Pathol.*, **22**, 23–33, 1973). Gross observations revealed involution of the cuticle along the tag pin to form an effective "open encapsulation."

The process of repair of this type of wound in penaeid shrimp consisted of infiltration of hemocytes eventually resulting in encapsulation of the pin and foreign or necrotic material with some melanization occurring. Wound repair continued with the deposition of collagenlike fibers along the axis of the wound and the secretion of a cuticle around the tag pin by the involuting epidermis. The fibrous tissue surrounding the tag pin consisted of fibrocytes in close association with many collagenlike fibers and was referred to as "granulation tissue."

Since the rapidity of the wound repair (16 days) prevented observations on the stability, duration, and possible resorption of this material, a study was carried out to determine if the fibrous "granulation tissue" surrounding the tag pin persists as scar tissue after removal of the pin.

The shrimp for this study were main-

[1] Contribution No. 367, National Marine Fisheries Service Gulf Coastal Fisheries Center, Galveston Laboratory, Galveston, Texas 77550.

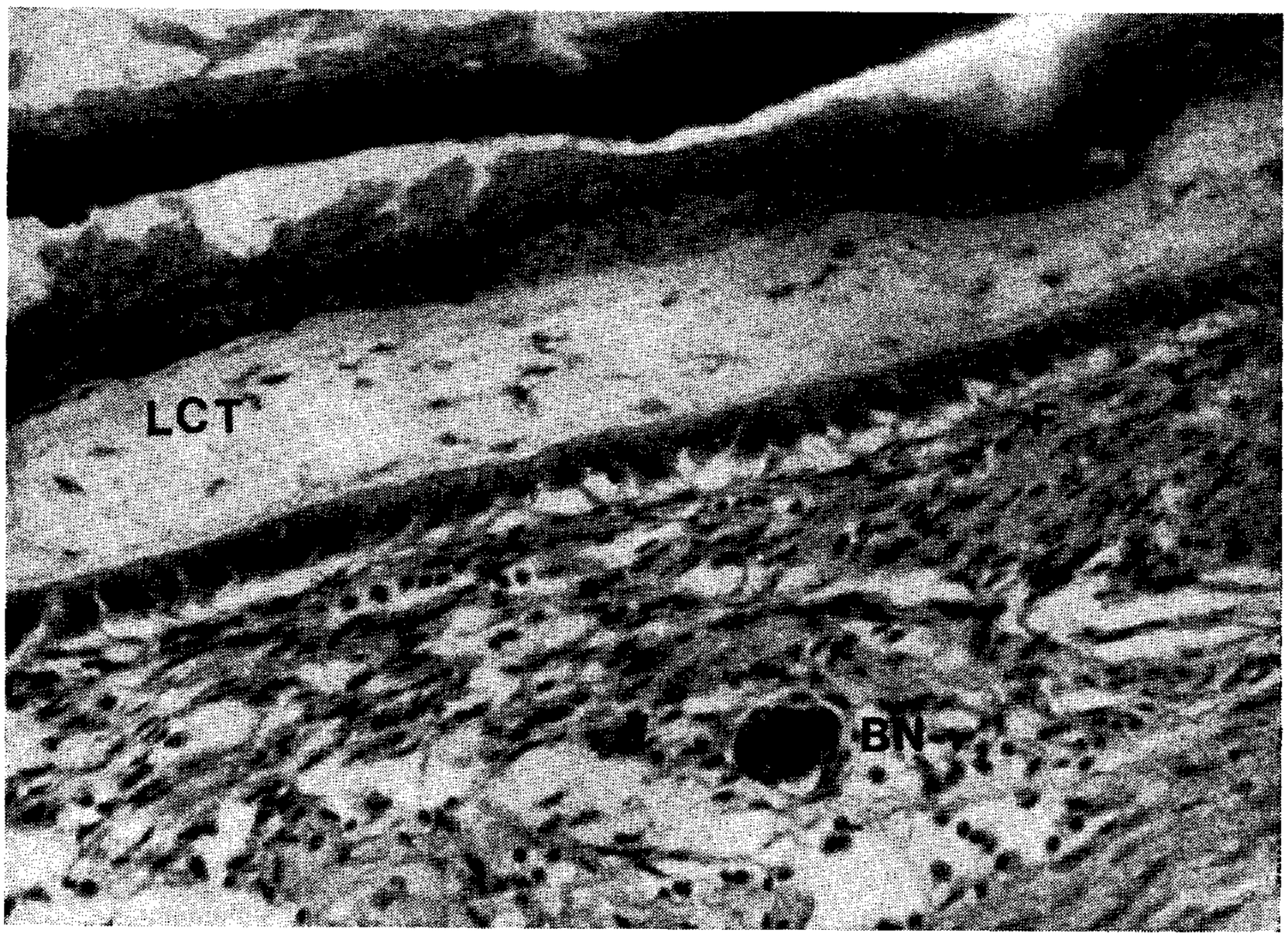

FIG. 1. The wound wall at 42 days post-tag removal; C = cuticle; LCT = loose connective tissue; E = epidermis; BN = brown nodule; and, F = fibrous material. Hematoxylin and eosin. ×220.

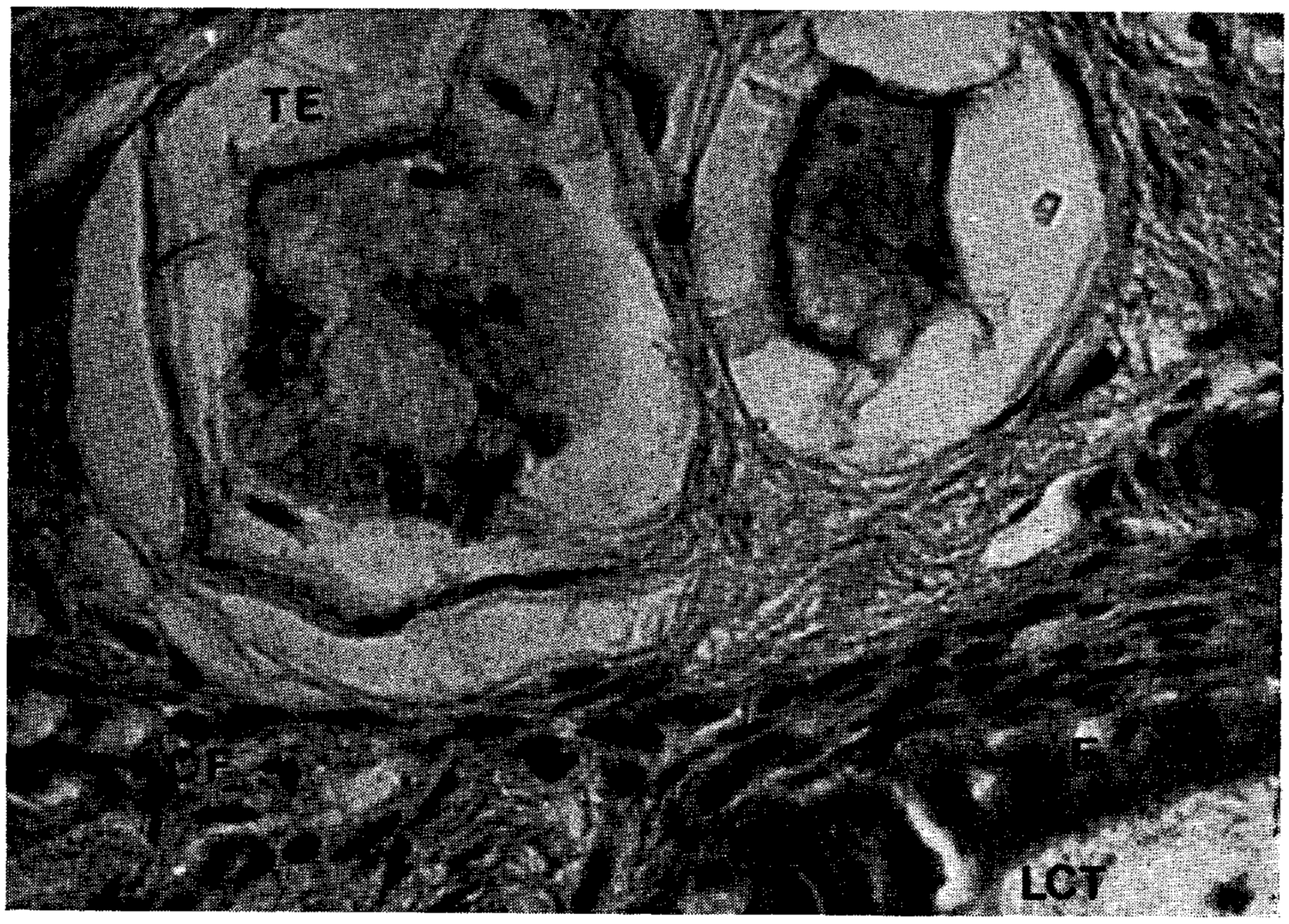

FIG. 2. Tegumental glands just basal to the wound channel epidermis at 42 days post-tag removal; LCT = loose connective tissue; E = epidermis; CF = collagenlike fibers; and, TE = tegumental gland. Hematoxylin and eosin. ×560.

tained at a temperature of 28°C and a salinity of 30‰. Test animals were tagged with the Petersen disk tag using standard techniques (R. A. Neal, *FAO Fish. Rep.* **57**, 1157, 1969) with no antibiotic. The tag pin was clipped and removed at 30 days post-tagging, at which time we began sampling. Samples were taken at 0, 2, 4, 8, 16, 26, 35, and 42 days after tag removal. Tissue samples were fixed in 10% phosphate-buffered formalin and were prepared for histological examination using routine procedures. Tissues were stained with hematoxylin and eosin, periodic acid-Schiff, Gram, and Chlorozol Black E.

The wound repair processes at 0 day after tag removal and at 42 days after tag removal (Fig. 1) were similar with no apparent changes. The cuticle (C), epidermis (E), and the loose connective tissue layer (LCT) surrounding the wound channel remained unchanged. The thick layer of fibrous material (F) underlying or basal to the epidermis also remained, and a definite line of demarcation delineated the wound from unaffected surrounding tissue. This fibrous material was composed of fibrocytes and collagenlike fibers interspersed with brown nodules (BN). Just basal to the epidermis along the wound channel, large tegumental glands (R. Dennell, Physiology of Crustacea," Vol. 1, Academic Press, N.Y., p. 455) were recognizable (Fig. 2). The integumental "tube" was not lost during molts, which occurred after removal of the tag pin.

It was apparent from our observations that the dense fibrous tissue formed around the tag pin became well organized, stable, and was not resorbed. The tissue was persistent, remaining as a mark long after the apparent "healing" of the wound and, therefore, may be correctly termed scar tissue.

C. T. FONTAINE
R. C. DYJAK
National Marine Fisheries Service
Gulf Coastal Fisheries Center
Galveston Laboratory
Galveston, Texas 77550

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